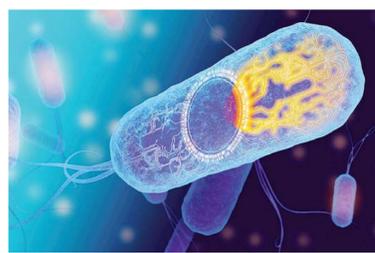


## #RESEARCH

# Engineered Gut Bacteria

Moon's method involves the development of a "bacterial sensor" that can detect certain chemicals in a person's gut. He has been working on similar sensors in his lab with the goal of ultimately genetically engineering a type of modular system with different sensors. He had already developed sensors for temperature, pH, oxygen levels, light, pollutants, and other disease-related chemicals.



Researchers are working toward genetically engineered bacteria that monitor chemical production from inside a person's gut and fix any imbalances.

Some of the trillions of bacteria living in your gut among viruses, eukaryotes, and archaea synthesize some of the neurotransmitters that are responsible for your nerves, anxiety, and euphoria. When you don't have enough or you have too much of any of these hormones, your mental health can suffer. Tae Seok Moon, associate professor in the department of energy, environmental, and chemical engineering at the McKelvey School of Engineering at Washington University in St. Louis, says he's experienced this imbalance himself. And he's working on a fix.

His latest work appears in the journal Cell Systems. "It is a difficult job to do," Moon says, "to keep your neurotransmitters balanced." But he has already begun. In 2017, Moon received a grant to engineer a probiotic specifically aimed at protecting people from the negative health effects of adrenaline surges.

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Moon isn't the first person to develop such sensors, but until now, they have mostly suffered from lack of specificity. Sensors can have difficulty when it comes to differentiating between similarly structured molecules. "Specificity in engineering is one of the big challenges," Moon says. "But we have proven that this can be done."

The proof is in the genetically engineered *Escherichia coli* Nissle 1917 (EcN) bacterium, which has a sensor for one and only one type of molecule.

The team was able to start with a sensor pathway found naturally in bacteria. First author Austin Rottinghaus, a PhD student in Moon's lab, and other lab members used computer modeling to explore

how mutations would affect the pathway's sensitivity. The researchers were able to develop a sensor pathway that was sensitive to the molecules they were interested in and only those molecules.

The sensors were incorporated into EcN, turning the bacteria into precision hunters. They could discriminate between phenylalanine (Phe) and tyrosine (Tyr), two structurally similar molecules associated with the disorders (PKU) and type 2 tyrosinemia, respectively.

The team also developed sensors for the similarly structured phenylethylamine (PEA) and tyramine (Tyr) both found in food and in the gut.

With this proof of concept, Moon's lab can now work on developing an actuator-protein that will act based on information gathered by the sensor. For instance, PKU is a genetic disease which causes babies to accumulate too much phenylalanine. A completely engineered bacteria might have a sensor to detect the amino acid and an actuator that can degrade it if the levels of phenylalanine are too high.

These kinds of engineered organisms can be useful beyond a medical setting. They also can be used to monitor food quality or to regulate pathways for microbial metabolic engineering, the processes used to create many pharmaceuticals, fuels, or other chemicals.

Because of his experiences, however, Moon is personally most interested in bacteria that can sense the levels of neurotransmitters in the gut. "If the levels are too high, the bacteria produce an enzyme that degrades the target chemical. If it's too low," he says, "the bacteria produce an enzyme that can synthesize more of it."

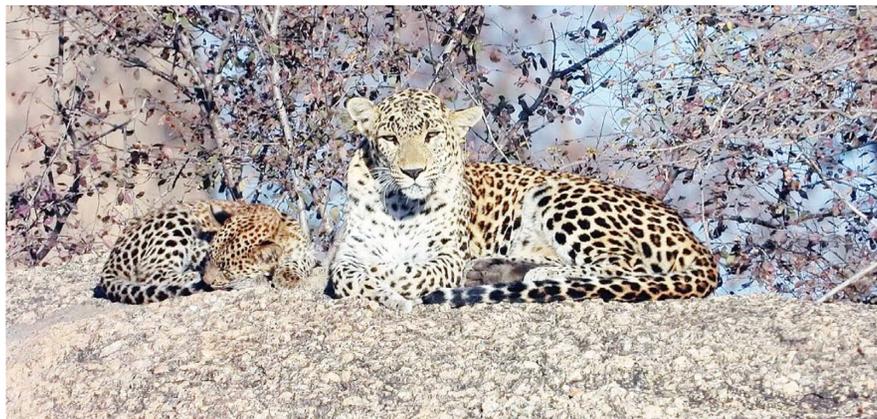
About 95% of the hormone serotonin is synthesized by bacteria in the gut. When this and other neurotransmitters are out of whack, a person can suffer greatly, Moon says. He wants to put an end to this suffering. "This is the beginning of our engineering solution."

This work had support from the National Institutes of Health, the Office of Naval Research, the United States Department of Agriculture, the National Science Foundation, and the National Science Foundation Graduate Research Fellowship Program.



Leopards in this area have a special relationship with the people. Like in most of India's countryside, if there is a high place, a rock, or a cave, it will have a temple in it. Nothing elaborate. Just a rock marked with vermilion powder to show that it is sacred. Why is it sacred? Nobody knows and nobody is asking. It is sacred and that's all there is to it. Sometimes, someone will bring a trishul (trident) and stick it into the earth near the rock and passers-by leave their offerings of food and light an incense stick or two to leave a mark of their devotion. These temples have become the haunts of the leopards of this region. The leopard is the most adaptable of all cats and uses high spots as vantage points to look for prey.

# Tigers Could Well Displace The Comfortable Leopard In Kumbhalgarh



## The Rewards of Nature

Khem runs a wonderful horse safari tour that goes thorough some of the loveliest Rajasthan countryside. Imagine staying at Khem Singh Rathore's ancestral property; a beautiful Haveli with interesting nooks and crannies and rooms in unexpected places. Some bedrooms opening out into balconies. Others onto a terrace with a very artistic gazebo on which to sit and have your morning cup of tea, watching the sun rise, listening to the calls of partridge and peafowl. Green Rose-ringed Parakeets abound, with the ancient walls of the forts and Havelis providing them with excellent holes as nesting sites. Early mornings ring with their noisy chatter and screeching.

The landscape is typical of the Aravalis and the Gorwar plains. Gorwar stretches along the edge of the Aravalis Hills and is bounded by Mewar in the south-east and Gujarat in the south-west. The region has an arid semi-desert climate and falls under the category of the North-western thorn scrub forests eco-region, as Wikipedia tells us. There are water bodies, small and large which mostly dry out in the harsh summer. But when I went there was still some water.

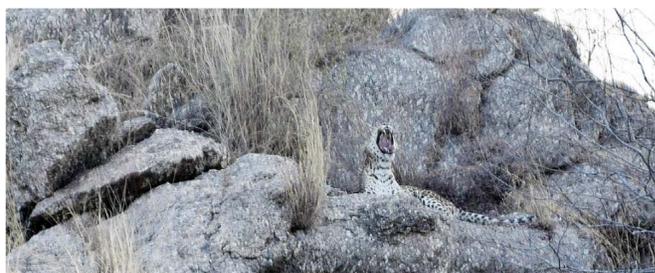
This attracts migratory birds like Bar-headed Geese and Demoiselle Cranes, especially because local village farmers plant millet and other annual crops in the lake beds. The silt that gets deposited in the annual flooding is ideal to grow these crops and water is at hand. Acacia is browsed upon by what look like feral camels, but which are owned by the villagers and are left to fend for their own

## #WILDLIFE

food until it is time to work. The leopards have fish and as the water recedes, they are easier to catch and attract the king of fishing eagles, the Osprey.

### Ideal for One

Sand dotted with acacia thorn bush and black rocks rising as small hillocks with caves where one rock supports another. Ideal habitat for the apex predator of this land, the leopard. Khem has Marwari horses, a local breed with the distinctive head of the Arab, large liquid eyes and ears with inward pointing tips. Hardy, intelligent, sure footed, and not above showing you their liking for good treatment with nuzzling you and their disapproval of bad treatment with taking a smack out of your behind. I love Marwari and



Kathiawar horses for their personality. They give as good as they get.

I wanted to see a leopard which this area is famous for. Khem called Mr. Bheraram Bishnoi, a Forest Guard, who is so typical of his breed, the Forest Guards of Indian Forest Department. Total dedication to his work which he loves, Bheraram Bishnoi, knows his leopards by name. He has a nice Nikon camera and takes some wonderful photos of all the wildlife which he loves. His love can be seen in his photos. The Rajasthan Forest Department is lucky to have a man like him. Bheraramji met us very early next morning while it was still dark and we walked up a very dry, slippery hillside and climbed almost to the top until we were sitting directly opposite a cave in the opposite hillside across the small ravine that separated the two hills. It was cold but very invigorating.

In that cave, Bheraram told us, a female hyena had given birth to a litter of three or four cubs. We



Khem ki Devi



Gazebo

could see signs of their feeding where the mother had dragged a shoulder of a dead cow to where her cubs could feed on it. We waited as the sun rose. A sight more splendid, one could hardly wish for. Partridge were calling all around us, the cocks re-staking their claim to their territory.

The mournful scream of peafowl announced that the sun was rising, but it was not time yet for them to descend from the safety of their perches. Peafowl are a staple diet for leopards in this area, and they are well aware of their status. Wildlife watching consists of a lot of waiting in silence with minimal to no movement; waiting for whoever you are watching for, to feel secure enough to emerge. We waited until the sun was well up in the sky but the mother hyena was not prepared to show us her cubs.

Eventually, we descended from hill and as we made our way back to the car which we had left parked on the road, we saw a leopard in the distance, sunning herself on a rocky outcrop about 300 meters from where we were. Bheraram told us that she also had cubs and was the competitor for the hyena mother for food for her brood. Talking to someone who is both knowledgeable and passionate about their work energizes you and so was the case of the time we spent with Mr. Bishnoi. I wish him all the best.

### Goodness of a Relationship

Leopards in this area have a special relationship with the people. Like in most of India's countryside, if there is a high place, a rock, or a cave, it will have a temple in it. Nothing elaborate. Just a rock marked with vermilion powder to show that it is sacred. Why is it sacred? Nobody knows and nobody is asking. It is sacred and that's all there is to it. Sometimes, someone will bring a trishul (trident) and stick it into the earth near the rock and passers-by leave their offerings of food and light an incense stick or two to leave a mark of their

devotion.

These temples have become the haunts of the leopards of this region. The leopard is the most adaptable of all cats and uses high spots as vantage points to look for prey.

These leopards compete with the Striped Hyena. Wiki has the following to say about this: The striped hyena (*Hyena*) is a species of hyena native to North and East Africa, the Middle East, the Caucasus, Central Asia and the Indian subcontinent. It is the only species in the genus *Hyena*. It is listed by the IUCN as near-threatened, as the global population is estimated to be under 10,000 mature individuals which continues to experience deliberate and incidental persecution. It is also the national animal of Lebanon. Hm! Why the national animal of Lebanon? Maybe because Macron is their favourite politician.

### Wonders of Some Views

I know Macron is French and not Lebanese. But the Lebanese invited him to go there and run their country because they forgot how to do it themselves. Hyena is the national animal! Indeed...

Well, to return to my story; the leopards of Gorwar are unique in that they have a special relationship with their human neighbours.



Striped Hyena



Gazebo

## Moon's Gravity

When the moon is directly overhead, you will weigh slightly less. The gravitational force of the Moon acting directly above the object, reduces the gravitational force of Earth a little. This is the reason. Weight force of gravity acting on the object reduces when Moon is directly overhead. It's calculated something like 0.48g lighter for a 100kg person. They're gonna be about 0.5g lighter when the moon is directly overhead.

## ff

Forest Department is lucky to have a man like him. Bheraramji met us very early next morning while it was still dark and we walked up a very dry, slippery hillside and climbed almost to the top until we were sitting directly opposite a cave in the opposite hillside across the small ravine that separated the two hills. It was cold but very invigorating.

They never attack human beings. They do take a sleeping dog or two or a goat likewise. But humans are simply left to be. People call these leopards. Temple Guardians. Nobody asked the leopards about this and so I can't tell you if they accept this responsibility or not. But the temples or rather the caves in which the temples are located are their home.

This is why you could be riding one of Khem Singh's horses and if you saw a leopard looking down at you from his rock-cave you may rest assured that he is not checking out his menu.

Leopards are so plentiful and as the apex predators, they are so bold that you get some very good sightings and photo ops and so this area has a multitude of resorts and safari lodges, as they are termed. Wildlife tourism, Indian style, is in full swing with green Maruti Gypsy jeeps zipping around like bugs around a flower.

Enter into this world, the tiger: I assume that if this area is to be designated a Tiger Reserve, tigers from some other reserve will be caught and released in Kumbhalgarh. What that is likely to do to the leopard and hyena population, when you introduce a super apex predator who will compete for the same prey animals, is not difficult to imagine. Tigers prey on Sambar (*Rusa unicolor*) or other large deer like Nilgai (*Boselaphus tragocamelus*) or Chital (*Axis axis*). I know that Kumbhalgarh has Sambar, but does it have enough to support a tiger population? If not, the tigers are going to hunt cattle. In an area as thickly populated as this, where cattle are routinely sent into the forest to graze, this is like offering candy to a kid. Human animal conflict is inevitable and so is its result.

May the powers that be, have the wisdom to address the issues involved and consider them long and hard before introducing tigers into an area that has not seen a tiger for over a century. | | | | |  
writetobar@rashtradrudoot.com

## #PSYCHOLOGY

Feeling a singer's pain, or recalling our own, may cause chemical changes within us. Clicking on those songs would be like clicking on our own metaphorical morphine drip.



# Why Sad Songs Make Us Feel Good

Adele's new album, 30, is finally available. Last month, hundreds of millions of us streamed its first single, Easy On Me. This song evokes feelings not easily put into words. But we can probably agree it is a sad song.

It isn't obvious that we should like sad music. Sadness is usually a feeling we try to avoid. An alien might expect us to find such music depressing and disliked.

Yet, sad music pulls us in and lifts us up. So, why does hearing sad music feel so good?

### The Biology of Sad Music

Let's start with biological theories. When we experience real-life loss, or empathize with another's pain, hormones such as prolactin and oxytocin are released within us. These help us cope with loss and pain. They do so by making us feel calmed, consoled and supported.

### The Psychology of Sad Music

A key reason we enjoy sad songs is because they profoundly "move" us. This experience is sometimes called *kamamuta*, a Sanskrit term meaning "moved by love". Feeling moved can involve chills, goosebumps, a flood of emotions (including romantic ones), a warmth in our chest and elation.

But why do we feel moved? The American writer James Baldwin got at this when he reflected: "The things that tormented me most were the very things that connected me with all the people who were alive, who had ever been alive." Similarly, feeling moved can come from us suddenly feeling closer to other people.

This may explain why the people most likely to feel moved by sad music are those high in empathy. Indeed, when we have listened to 30 we may turn to reaction videos to see how others feel. This lets us share an emotional experience with others. A sense of

communal sharing boosts our feeling of being moved and triggers feelings of comfort and belonging.

A related suggestion is that Adele's sad music can be a friend to us. It can act as a social surrogate. Sad music can be experienced as an imaginary friend who provides support and empathy after loss.

Feeling moved can also result from memories being triggered of important moments of our lives. Adele's songs are powerfully nostalgic. It may be nostalgia, rather than sadness, that we enjoy.

Indeed, when people listen to sad music, only around 25% say they actually feel sad. The remainder experience other, often related emotions, most commonly nostalgia. This feeling of nostalgia can help increase our sense of social connectedness, mitigate feelings of meaninglessness, and reduce anxiety.

A completely different type of psychological theory is that Adele's songs are emotional gyms. They give us a safe, controlled space in which we can explore simulated sadness. They are the emotional equivalent of Neo sparing with Morpheus in the Matrix movie.

Simulated sadness lets us experiment with and learn from this emotion. We can enhance our empathy, learn to better see things from other people's perspectives, and try out various responses to sadness. This may make us better prepared for when real loss strikes. Such learning experiences may have evolved to be pleasurable to

encourage their use. **Making Sense of Sadness** Alternatively, it could be that Adele's songs aren't pleasurable because they are sad or nostalgic. They may be pleasurable simply because they are beautiful. Sadness might just happen to coincide with beauty. Indeed, seeing acts of moral virtue or beauty have been suggested to provoke feelings of elevation and can touch, move and inspire us.

We can also think at the cultural level. Here we can view the pleasure Adele's songs give us in terms of the meaning she helps us make. Adele takes hard life experiences and helps make sense of them.

This is what much tragic art does. It takes the pain and the suffering and the sadness of the world and gives it meaning. As the German philosopher Friedrich Nietzsche once put it, someone who has a why to live can bear it almost anyhow.

Ultimately, Adele's songs will mean something different to each of us. We listen to sad music when we want to reflect, belong, or relax. We listen to experience beauty, receive comfort or reminisce. But to all of us, Adele's songs say: you are not alone in your pain. They let us feel her pain, share our suffering, and connect with others' past and present. And in the sharedness of our humanity is beauty.



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### Making Sense of Sadness

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## THE WALL



## BABY BLUES



By Rick Kirkman & Jerry Scott

## ZITS



By Jerry Scott & Jim Borgman